# GALILEO



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LV/Range: STS-IUS/ETR

Launch Date: October 18, 1989
Projected SC Life/DSN Support: 10 years/10 years

Project Responsibility: Jet Propulsion Laboratory (JPL)

Source: SIRD May, 1988; NSP November, 1988
Sponsor: OSO

## A. MISSION DESCRIPTION

The purpose of the Galileo missions is to make observations of Jupiter and its satellites using an orbiting spacecraft and an atmospheric entry probe. The mission will determine the chemical composition and physical state of the Jovian atmosphere and its satellites, and the topology and behavior of the magnetic field and energetic particle flux of Jupiter.

## B. FLIGHT PROFILE

The current Galileo Mission Plan calls for a Venus Earth Earth Gravity Assist (VEEGA) trajectory having a launch to end-of-mission duration of approximately 8 years.

The Galileo spacecraft consisting of an Orbiter and a Probe, together with an Intertial Upper Stage (IUS), was placed in Earth orbit by the Space

Transportation System (STS) on October 18, 1989. The IUS placed the spacecraft on a trajectory to encounter Venus (20,000-km altitude) on February 10, 1990. The first Earth encounter (1000-km altitude) occurred on December 8, 1990. A second Earth encounter occurring on December 8, 1992 at 300-km altitude will establish the final trajectory to Jupiter with arrival date of December 7, 1995.

The Probe will be released 150 days prior to Jupiter arrival and will enter the Jovian atmosphere at just prior to JOI. During descent, the Probe will transmit its telemetry data directly to the orbiter for playback to Earth as soon as possible thereafter.

Following JOI, the orbiter will commence a 22-month, 10-satellite tour to complete the mission by July 1997.

## C. COVERAGE

### 1. Coverage Goals

The current (1/91) estimate of the antenna coverage profile is given below. IOM GLL-MDT-90-141 is the basis for the updates to the profile as defined in the SIRD. This profile reflects the changes induced by the actual launch on 18 October 1989. Such changes include time of oppositions and conjunctions, size and locations of maneuvers, and a more comprehensive understanding of spacecraft performance. This will be refined as the actual mission design progresses. Note that the support rate is given in passes per month (ppm) for all mission phases, even though the duration of several phases is much less than one month.

| Mission Phase | Period | | Passes/Month | Antennas |
|---|---|---|---|---|
| (a) Launch | 10/89 | 10/89 | 5 | 26m |
| | | | 5 | 34 STD |
| | | | 39 | 70m |
| (b) Cruise | 11/89 | 12/89 | 88 | 70m |
| (c) Venus Encounter | 1/90 | 2/90 | 3 | 34 STD |
| | | | 56 | 70m |
| (d) Cruise | 3/90 | 10/90 | 2 | 34 STD |
| | | | 40 | 70m |
| (e) Earth Encounter 1 | 11/90 | 12/90 | 6 | 26m |
| | | | 6 | 34 STD |
| | | | 80 | 70m |
| (f) Cruise | 1/91 | 9/91 | 13 | 34 HEF |
| | | | 20 | 70m |
| (g) Gaspra Encounter | 10/91 | 11/91 | 11 | 34 HEF |
| | | | 35 | 70m |

| Mission Phase | Period | | Passes/Month | Antennas |
|---|---|---|---|---|
| (h) Conjunction 1 | 12/91 | 2/92 | 62 | 34 HEF |
| | | | 4 | 70m |
| (i) Cruise Science | 3/92 | 9/92 | 4 | 34 HEF |
| | | | 12 | 70m |
| (j) Earth Encounter 2 | 10/92 | 12/92 | 16 | 34 HEF |
| | | | 70 | 70m |
| | | | 6 | 26m |
| (k) Cruise Science | 1/93 | 2/93 | 30 | 34 HEF |
| | | | 4 | 70m |
| (l) Opposition 3 | 3/93 | 3/93 | 10 | 34 HEF |
| | | | 4 | 70m |
| (m) Cruise Science | 4/93 | 7/93 | 12 | 34 HEF |
| | | | 8 | 70m |
| (n) TCM | 8/93 | 9/93 | 8 | 34 HEF |
| | | | 42 | 70m |
| (o) Cruise Science | 10/93 | 3/94 | 36 | 34 HEF |
| | | | 7 | 70m |
| (p) Opposition 4, Gravity Wave | 4/94 | 4/94 | 90 | 34 HEf |
| | | | 4 | 70m |
| (q) Cruise Science | 5/94 | 1/95 | 36 | 34 HEF |
| | | | 4 | 70m |
| (r) Probe Release, Opposition 5 | 2/95 | 7/95 | 36 | 34 HEF |
| | | | 20 | 70m |
| (s) Pre JOI | 8/95 | 9/95 | 3 | 34 BWG |
| | | | 9 | 34 HEF |
| | | | 28 | 70m |
| (t) Pre JOI | 10/95 | 10/95 | 6 | 34 BWG |
| | | | 90 | 70 34 HEF |
| | | | 90 | 70 70m |
| (u) Jupiter Orbit Insertion | 11/95 | 12/95 | 90 | 34 BWG |
| | | | 90 | 34 HEF |
| | | | 90 | 70m |
| (v) Tour | 1/96 | 10/97 | 28 | 34 BWG |
| | | | 15 | 34 HEF |
| | | | 50 | 70m |

2. Network Support

DSN support will be provided as indicated in the following table:

| System | Goldstone | | | | Canberra | | | | Madrid | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 12 | 14 | 15 | 16 | 42 | 43 | 45 | 46 | 61 | 63 | 66 |
| S-band TLM | P | P | | * | P | P | | | P | P | * |
| X-band TLM | P | P | P | | P | P | P | | P | P | |
| S-band CMD | P | P | | * | P | P | | | P | P | * |
| X-band CMD | | | P | | | | P | | | | |
| S-band TRK | P | P | P | * | P | P | | | P | P | * |
| X-band TRK | P | P | | | P | P | | | | | |

NOTE: P = Prime; * = 26-m S-band support for near-Earth support only.

3. Prelaunch System Tests

Prelaunch and system testing was supported by MIL 71.

D. FREQUENCY ASSIGNMENTS

Frequencies are allocated according to the following table:

| System | Uplink (MHz) | Downlink (MHz) | Polarization |
|---|---|---|---|
| S-band TLM | -- | 2295.0/2296.5 | Linear/RCP* |
| X-band TLM | -- | 8415.0/8420.4 | RCP |
| S-band CMD | 2114.7 (Prime)<br>2113.3 (Spare) | -- | RCP* |
| X-band CMD | 7166.9 | -- | RCP |

| System | Uplink (MHz) | Downlink (MHz) | Polarization |
|---|---|---|---|
| S-band TRK | 2114.7 | 2296.5 | Linear/RCP* |
| X-band TRK | 7166.9 (Prime)<br>7162.3 (Spare) | 8420.4 | RCP |

Note: *S-band HGA equals Linear
S-band LGA equals RCP

## E. SUPPORT PARAMETERS

The support parameters for the Telemetry, Command, and Support Systems are listed below:

(1) Telemetry

| | |
|---|---|
| Data Streams | 2 |
| Format | PCM(NRZ)/PSK/PM |
| Subcarrier Frequency | 22.5, 360 kHz |
| Bit Rate | 10, 40, 1200 b/s<br>7.68, 168, 28.8, 67.2, 80.64,<br>115.2, 134.4 Kb/s |
| Record | Required |
| Coding | Convolutional, K=7 R=1/2;<br>K=15 R=1/4 (115, 134.4 Kb/s only) |

(2) Command

| | |
|---|---|
| Format | PCM (Manchester encoded)/PSK/PM |
| Bit Rate | 32 b/s |
| Subcarrier Frequency | 512 Hz |

(3) Support

| | |
|---|---|
| Uplink Power | 10 to 125 kW |
| Antenna Rate | Sidereal, except at launch |
| Antenna Angle Data | Not required |
| Antenna Autotrack | First pass (26-m autotrack) |
| Doppler Rates | Moderate, except first pass<br>and encounter |
| Range Format | Standard DSN |
| Recording | |
| . Analog | Not required |
| . Digital | Required |
| . VLBI | ΔDOR |

## F. TRACKING SUPPORT RESPONSIBILITY

The allocation of responsibilities for tracking support is listed in the following table:

| Mission Phase | Support Responsibility |
|---|---|
| STS Launch (complete) | TDRSS |
| IUS Injection (complete) | RTS |
| Cruise/Planetary (in progress) | DSN |

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